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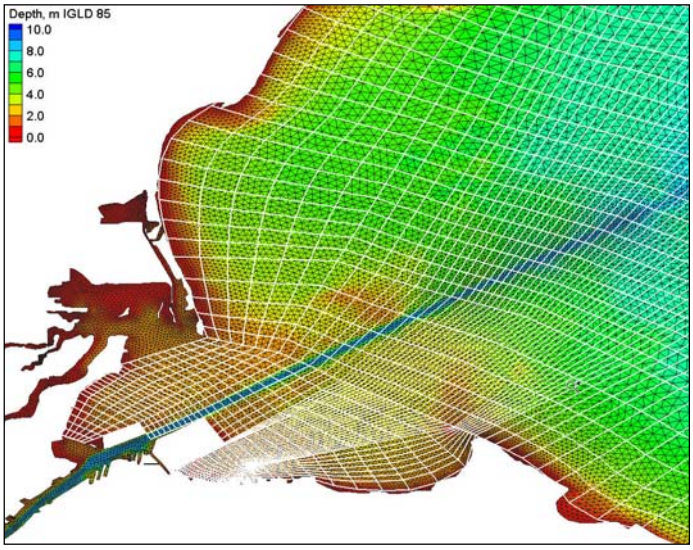
Engineer Research and Development Center

Nearshore Circulation and Thermal Modeling Suite for Western Lake Erie

Description

CHL, in support of the Buffalo District (LRB), is developing a nearshore circulation and thermal modeling system and providing user training. This will enable LRB to analyze the impacts of placement location of Confined Disposal Facilities (CDFs)/Habitat Restoration Units (HRUs) and open-lake dredged material placement sites (ODMPSs). Of specific interest is the effect of placement locations on nearshore temperature distribution in the vicinity of Maumee Bay near Toledo, Ohio.

Issue



The circulation of the waters adjacent to Maumee Bay in western Lake Erie varies on a seasonal basis and is driven primarily by winds, atmospheric pressure, fresh water inflows and outflows, as well as baroclinic-induced circulation influenced by air-lake temperature differences and inflow/lake temperature differences. Although the majority of Lake Erie is ice covered during the winter, there are concerns that the Toledo Edison Bayshore Power Plant discharge retards the development of shore-fast ice within Maumee Bay. A number of modeling scenarios of circulation and wave patterns with and without the CDFs/HRUs/ODMPSs in place for a range of storm and non-storm conditions are being performed to accurately characterize lake circulation and the horizontal thermal distribution within and around Maumee Bay resulting from future CDF/HRU/ODMPS placement.

Products

1. A complete Western Lake Erie nearshore circulation and thermal modeling suite including grids, model input files, and documentation of methodologies and procedures. 2. Training and consultation in simulation execution and analysis of results.

Supporting Technology

ADCIRC, a two-dimensional depth-integrated hydrodynamic model predicts the lake-wide water surface elevation and current distribution resulting from atmospheric forcing and tributary inflows/outflows. STWAVE is a spectral wave transformation model, which is capable of representing wave-current interaction (wave-action equation, current-induced breaking, and wave blocking by a current). The Hydrodynamic Steering Module of the Surface-water Modeling System (SMS) allows ADCIRC and STWAVE models to share information so that the combined effects of waves and currents are simulated with and without the CDFs/HRUs/ODMPSs in place for a range of storm and non-storm conditions. CH3D, a three-dimensional hydrodynamic, salinity, and thermal transport model, utilizes

near-field surface elevation boundary conditions, derived from ADCIRC, to predict the effect of dredge material placement on the distribution of the thermal plume produced by the Toledo Edison Bayshore Power Plant.

Benefits Provides LRB the capability (a modeling system) to evaluate future placement of CDFs/HRUs/ODMPSs to minimize adverse impacts to circulation and thermal plume distribution within and around Maumee Bay, Toledo, Ohio. Provides hydrodynamic inputs for future modeling of sediment fate to evaluate dredging operations, placement operations, and post-placement long-term effects on the surrounding environment.

Sponsor US Army Engineer District, Buffalo.

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